Biology

Speciation by a wandering river

Textbook explanations of the fantastic elaboration of species in the Amazon and other tropical areas have relied on stability as a key factor. Seasonless years and an invariant environment, the theory goes, have provided the opportunity for great numbers of species to evolve and coexist.

But recent studies have shown that there are seasonal variations in temperature in the tropics, as well as variations between years. And according to Phyllis Coley of the University of Utah in Salt Lake City and her colleagues at the University of Turku in Finland, in the Peruvian Amazon the physical environment itself is subject to great and recurring changes. Meandering rivers cause large-scale disturbances in the Peruvian forest, the researchers say; it may be these changes, rather than stability, that are responsible for the diversity of tropical species.

The researchers, who analyzed Landsat images, report in the July 17 NATURE that more than 26 percent of the lowland forest shows signs of recent erosion and new soil deposition; 12 percent of the lowland forest is in successional stages along rivers. "People had never really thought in terms of the habitat being destroyed on such a large scale," Coley says. "But most of the Amazon is fairly low, flat country. . . . This is actually destroying and creating lots of new habitat."

That means the forest, far from being uniform, is a mosaic of patches of different ages, which may help maintain a diversity of species adapted to different successional stages. Soil laid down during successive floods can vary among patches as well, increasing opportunities for differing species. And the dynamic nature of the environment may have played a role in the origin of tropical diversity, the researchers say: The flipping coils of the river may at times isolate populations and allow speciation.

Conservation efforts should take into account the emerging notions about the dynamic nature of the tropics, Coley says. If parks are set aside, "You would like to include large enough areas so that when the river continues to move you're not wiping out the only mature forest left."

Hemoglobin: How old is it?

Hemoglobin, the molecule that transports oxygen, is one of those things we so-called "higher" organisms thought we had all to ourselves. But it looks as though we'll have to share the honors with at least one variety of bacteria.

Hemoglobin is made up of polypeptide chains and iron-containing heme groups that bind loosely with oxygen. Though much of the amino acid sequence of the polypeptides varies among different plant and animal species, certain key spots in the sequence are highly conserved. According to Daniel Webster of the Illinois Institute of Technology in Chicago and his colleagues at Japan's Osaka University, the bacteria *Vitreoscilla* synthesizes a hemeprotein whose sequence in those key points is characteristic of the globins; the protein's three-dimensional alignment is similar as well. And it seems to serve a similar function: The concentration of *Vitreoscilla's* hemoglobin shoots up when the bacteria, which need oxygen to survive, are grown under low-oxygen conditions.

Does this mean that hemoglobin originated in prokaryotes, those nucleusless organisms widely considered more primitive? Or is this an example of convergent evolution, with very different species devising similar solutions to shared problems? (Another possibility: The bacteria could have acquired the genes for the hemoglobin from a eukaryote in some sort of gene transfer.) Says Max Perutz of the Laboratory of Molecular Biology in Cambridge, England, who commented on the finding in the July 31 NATURE, where the work was reported, "Who can guess? We were not there when it happened."

Earth Sciences

Connect the dots in the ocean crust

Until recently, scientists have been hard-pressed to get both the big picture and the detailed picture of the ocean floor at the same time. Seismic reflection profiling – produced by sending sound waves through crustal layers – paints a broad-brush outline of the seafloor structure. However, while seismic images cover vast areas of oceans, they don't reveal the chemistry or age of the crustal layers. For this kind of detailed information, scientists study cores from drill holes. But drill holes only dot the ocean floor over a mere fraction of the globe.

Now, with advancements in both drilling and seismic imaging technologies, scientists can correlate what they drill in isolated spots to what they seismically image over large areas. This will enable them to use seismic profiles to date and classify crustal layers far from drill holes.

In the Aug. 15 SCIENCE, Larry Mayer at Dalhousie University in Halifax, Nova Scotia, and his co-workers report that they used drill cores to link up and date a series of seismic reflectors (the boundaries between layers of different rock types) across the central equatorial Pacific Ocean.

Mayer directly measured some of the properties of core rocks retrieved during the Deep Sea Drilling Project's Leg 85, one of the first to produce complete, undisturbed cores. From the measured properties, Mayer produced a synthetic seismic profile that clearly matched the real seismic records. Previously, says Edward Winterer, one co-author at Scripps Institution of Oceanography in La Jolla, Calif., "No one had even come close to that because of the crudity of the technologies. We nearly went crazy."

The drill cores showed that the reflectors had formed when the amount of calcium carbonate being deposited and preserved on the ocean floor had changed. Because the influx of cold, carbonate-poor waters from the North Atlantic and Antarctica dissolve carbonate, the researchers think the reflectors were created during major changes in the circulation of Pacific bottom waters over the last 20 million years or so.

"We're now very hopeful that the reflection profile records, which we use conventionally to extend the detail information we get from drill holes, will become more readable, and readable in terms of the oceanography of long-ago oceans," Winterer concludes.

Send in the clouds

Clouds are the main middlemen between the sun and earth; more than anything else, they determine how much solar energy reaches the planet and how much of it is reflected back into space. However, scientists have not been entirely clear on the quantitative role clouds play in this radiation budget, and this has been a major hitch in the development of climate models and predictions of the "greenhouse" warming brought on by increases in carbon dioxide and other gases. Some scientists have suggested that increases in cloud cover might cool the atmosphere, offsetting greenhouse warming. But without hard data on clouds' effects on the present-day climate, such suggestions regarding their future effects remain wispy.

For this reason, NASA began its Earth Radiation Budget Experiment (ERBE) in October 1984. According to Experiment Scientist Bruce Barkstrom at Langley Research Center in Hampton, Va., preliminary results, based on a few months' data, indicate that clouds reflect more solar energy than they retain, keeping the atmosphere from absorbing roughly 25 watts per square meter than if they weren't there. This suggests a net cooling effect on the atmosphere. With two satellites up and one to be launched at the end of this month, researchers expect ERBE to provide much more accurate and easily used data for directly assessing the role of clouds than what was available previously.